**1. Problem Statement**

Wherever a person goes to a country with high population density areas, a parking issue will most likely be present. There is no difference in the case of Qatar as it is becoming a crowded country and one of those crowded places is Qatar University (QU). Students in QU started becoming more independent in their everyday life, and that involves driving a car. The number of students owning a car is increasing each year drastically in QU, not to mention the number of students QU accepts each year which led to the demand for more parking spots. As Qatar University students, we are motivated to come up with a solution to this problem.

In Qatar University (QU), there is an increase in the number of students annually, which leads to an increase in the number of vehicles arriving at the campus as well. According to the Ministry of Education statistics from 2012, the number of students attending QU has exceeded ten thousand students [1] and is only increasing with each passing year. Likewise, the number of staff and faculty that also need parking for their vehicles has increased. Today, the number of students at Qatar University has reached more than 20,000 [2]. As a result, there has been a rapid increase in the number of people and their vehicles on campus, and with the limited available parking spaces, parking problems are bound to exist. An online survey shared with Qatar University students to assess the severity of the parking problem. 94.3% of the survey respondents believe that there is a real problem in finding a vacant parking spot inside the campus as shown in Figure 1-1.

Frustrated students have taken to social media to air their criticism on the ongoing crisis of parking areas at Qatar University [3]. Students circulated comments, pictures, and videos that represent their daily suffering due to the lack of parking spaces allocated to them in the university.

Many of sarcastic and critical tweets discussed out this issue as displayed in Figures 1-8 until 1-11 below.

The problem has surpassed student conversation to become the talk of the media in Qatar. Figures 1-2 up to 1-7 show Qatari newspapers Al-Raya, Al-Watan, Al-Arab and Al-Sharq’s headlines discuss the parking problem at Qatar University and its impact. The articles highlighted that the effects of this problem were not only limited to students and staff but also impacted the university’s visiting guests who come for events, ceremonies, seminars or conferences.

People looking for an empty parking spot is one of the significant causes of congestion and wastes the time of students and staff. As shown in Figure 1-12, more than 60% of the students who responded to our survey reported that they take more than 15 minutes to find a vacant parking spot. To a student, 15 minutes late could mean being late to an exam or a quiz. Also, if the professor took attendance at the start of the lecture, the student may be considered absent. Qatar University follows an attendance policy that states that a student automatically fails a course if he/she is absent more than 25% of the course time. Hence, if the problem continues, the student can exceed the allowable times he/she can be absent and fail the course. As a result, a considerable number of students declared that they are forced to come to the university early so that they can get a parking slot for their cars [5].

Even though people rarely notice or discuss the environmental impact, the parking problem creates indirect environmental effects as it causes vehicles to consume more fuel while driving around to search for parking spots. The increase in fuel consumption wastes the vehicle owner’s money and leads to more CO2 emissions.

Additionally, hurried drivers are forced to park in illegal parking places which in turn leads to an increase in the number of traffic violations and accidents inside the campus. Figures 1-13 and 1-14 below show examples of illegal parking where cars are parked over sidewalks and on the grass field.

In the end, the university’s reputation is negatively affected with the crisis of parking areas, because it is the first thing that guests see when visiting and students and staff notice when they start their day.

The technical challenges we may face doing this project:

1. Ultrasonic sensors might not detect a car if it is not close enough.

2. Additional financial and physical resources will be required to scale the system.

3. Internet connection profoundly affects keeping the system in real time

4. Android application must keep up to date with the latest Android version.

5. Android application must be a scalable and extendable, user-friendly application with a high level of performance and services.

**2. Project Significance**

A parking system is needed to organize and utilize the parking area resources. The parking system can guide the vehicle owners at the university to reduce traffic overcrowdings by suggesting different routes at the campus roads. The system can reduce the vehicle owner’s search time significantly due to the information provided by the smart parking system. As a result, traffic congestion decreases and the university could fine vehicle owners when they park illegally.

A smart parking system will not only be beneficial for Qatar University’ attendants but is also considered valuable for the car parking operators and customers as well as the environment [6][7]. For the parking operators, the data gathered via the implementation of the parking system can be used to predict future parking patterns. Pricing strategies can also be manipulated based on the information gained to increase the university’s profit. In terms of environment protection, decreasing cars emission in the air reduces the level of pollution [6].

**3. Project Objectives**

1. To design and implement a system that can manage parking areas.

2. To use sensors (Ultrasonic Sensor and RFID Reader) to collect data.

3. To use microcontroller boards (Arduino) to receive data from used sensors and send it to a database (Firebase) for storage.

4. To design an Android application and a website.